The position of the squall-line can be determined by the following criteria, the demonstration of which is given later:

1. Slight convergence of winds, which in the case of Washington charts is often obliterated by the use of only eight wind directions. Increased velocities.
2. Temperature discontinuities, with more marked fall at the stations where the line has passed.
3. Rising barometer with the passage of the line, determined from the 24-hour abnormal change.
4. Precipitation and cloudiness with the passage of the line, followed by clearing weather.

A common phenomenon with the passage of the squall surface in the warm season is the thundershower. This is not the local thunderstorm due to intense heating, but a typical cold-front phenomenon.

The low-pressure area mentioned above had not one but a fan of squall-lines, one line lying well along the eastern edge of the Mississippi Valley marked by strong wind convergence, strong temperature, and pressure discontinuities, the difference in temperature between Shreveport and Dallas being 22°, Little Rock and Fort Smith 20°, St. Louis and Columbia, Mo., 12°. The pressure increases rapidly in a series of steps to the north, as shown by the chart, and three at least, possibly five portions, of squall-lines can be identified; for example, that between Valentine and North Platte, the temperature difference being 4°, the fall 16° at Valentine compared with 6° at North Platte, the wind west at the latter station with the weather clear, while the former has a northwest wind accompanied by snow, the precipitation for the 24-hour period is already 0.02 inch.

These LOWS, together with a third central in British Columbia, are the last of a series begun in December. The one central over Lake Superior on the second has moved to the northeast to the south shore of Hudson Bay. The secondary squall lines are becoming very complicated, at least five secondaries appearing, one over the northern part of Texas being a well-developed LOW. By the third this secondary is giving heavy rain in the lower Mississippi Valley.

The map on the 4th at 8 a. m. is very complicated. The secondary mentioned has swept off to the Atlantic, while the LOW from the Pacific coast now lies north of the Great Lakes.

This series is terminated by an area of high pressure growing over the Winnepeg district, its cooling temperatures extending far south, so that the polar front lies off the Atlantic coast, south in or below the Gulf of Mexico, and then the warm front of the first of the new series carries it nearly due north along the borders of the Plateau district to the center of the low, which for purposes of discussion we will call B, the A series being considered as closed by the cold outbreak under observation.[29] * * *

DISCUSSION.

By ALFRED J. HENRY.

Chart A. L. B. I is the Daily Weather Map for January 1, 1921, redrawn from the map submitted by Miss Beck and altered very slightly as to the position of the polar front in the rear of the cyclone center. In redrawing the map I have used only wind directions for those stations at which the velocity was at least 10 miles per hour (4.5 m. p. s.). This was done in order to eliminate from consideration the records for stations at which light winds or calms prevailed.

The result of this omission is, first, the lines of flow as indicated by the long heavy arrows are based upon a smaller number of actual observations, and second, some directions that did not conform to the general lines of flow, probably due to light winds or calms have been eliminated from consideration.

That part of the polar front line figured by the heavy broken line in red is precisely as drawn by Miss Beck from a consideration of all the data, but the polar front in the rear of the cyclone center makes a sharp westward bend over Nebraska and an equally sharp return to the eastward over southern Kansas and Missouri. In thus drawing the line a number of northwest winds in the upper Mississippi Valley were ignored, since it seems probable that the shift of the wind to that direction must have occurred very close to the moment of observation. The temperature at the stations so ignored showed very little fall from the readings 24 hours previous.

The eastward inflection of the line over southern Kansas is illustrative of the manner in which a wedge of cold air rather frequently penetrates into the warmer air in the southern segment of a cyclone. From the forecasters point of view such a condition if carried on in an extensive scale means the extinguishment of the cyclone, but if only to a small extent, as here illustrated, it simply makes for a diminution in the amount of cooling experienced in the rear of the cyclone, since the colder air is manifestly soon shut off from the original supply.

The paucity of data of wind velocities west of the Rocky Mountains is strikingly illustrated by the chart in question. The remainder of the maps for January, 1921, considered by Miss Beck, have not been reproduced for want of space, and for other reasons. Many of the maps were unsatisfactory for the reasons so clearly stated by Miss Beck on a previous page.

It may not be amiss to here consider very briefly the suggestions of Professor Bjerknes in a previous article[29] that the number of telegraphic stations in the United States be increased by about 4,500. A little calculation will uncover the difficulties which lie in the way of carrying out the suggestion. The number of telegraphic stations at present is slightly more than 200. Under the most favorable conditions the data from these stations can be charted in 35 minutes and, allowing 15 minutes additional for generalizing the data, the forecaster is able to begin issuing forecasts within an hour from the time of observation. If the number of telegraphic stations should be increased upward of twenty-fold it would be physically impossible to chart and generalize the data within a reasonable time after the observing hour, even if the present district forecast centers, of which there are 5, should utilize reports from only such additional stations as would lie within their respective geographic districts.

[29] The remainder of the article takes up in detail the discussion of the groups of cyclones that crossed the United States in January, 1921. Space does not permit the reproduction of the series of maps, but the originals have been filed in the Weather Bureau library and are available to students and others who may wish to consult them. —Ed.

[29] See footnote 27.